THAT WHICH IS CLAIMED:

1. A gyratory compactor apparatus adapted to interact with a generally cylindrical mold having an outer diameter and defining an axis, the mold also having opposed first and second ends and a radially extending flange, the flange having an outer diameter, and the mold being adapted to have a sample disposed therein, said gyratory compactor apparatus comprising:

a frame defining an axis;

a mold-engaging device adapted to receive the mold and to axially move the mold with respect to the frame; and

an offsetable member operably engaged with the frame and configured to be capable of engaging the second end of the mold when the mold is axially moved into engagement with the offsetable member by the mold-engaging device, the mold-engaging device being further configured to then release the mold such that the mold is independent thereof, the offsetable member being further configured to be capable of being displaced from the frame axis and concurrently movable in an orbital motion about the frame axis, with a portion of the mold away from the second end being maintained at a gyration point along the frame axis, such that the second end of the mold is moved in the orbital motion and the mold is thereby gyrated and capable of being dynamically maintained at a gyration angle related to the displacement of the offsetable member, the gyration point, and the frame axis.

2. An apparatus according to Claim 1 further comprising a rotatable member configured to be rotatable about the frame axis, the rotatable member being configured to support the offsetable member such that the offsetable member is laterally movable with respect thereto.

3. An apparatus according to Claim 1 further comprising a securing device operably engaged with the offsetable member and configured to secure the second end of the mold to the offsetable member as the mold is gyrated.

4. An apparatus according to Claim 1 further comprising a pressure ram operably and movably engaged with the frame and configured to be capable of moving along the frame axis through the first end of the mold so as to apply a compaction pressure on the sample within the mold, the pressure ram thereby maintaining the portion of the mold at the gyration point along the frame axis.

5. An apparatus according to Claim 4 wherein the pressure ram includes a ram head configured to extend into the first end of the mold so as to engage the sample, the ram head being configured to maintain the portion of the mold at the gyration point along the frame axis.

6. An apparatus according to Claim 4 further comprising a controller in communication with and capable of controlling the pressure ram and the offsetable member, the controller being configured to dynamically direct the pressure ram to apply and maintain the compaction pressure and the offsetable member to provide and maintain the gyration angle.

7. An apparatus according to Claim 6 further comprising a compaction pressure sensing device in communication with the controller and configured to determine the compaction pressure exerted on the sample.

8. An apparatus according to Claim 6 further comprising a mold angle sensing device in communication with the controller and configured to determine the gyration angle of the mold.

9. An apparatus according to Claim 1 further comprising an anti-rotation device operably engaged with the frame, the anti-rotation device being configured to be

capable of engaging the mold as the mold is being gyrated so as to substantially prevent the mold from rotating about the mold axis.

10. An apparatus according to Claim 1 wherein the mold-engaging device further comprises:

a movable mounting plate configured to be movable between a first position and a second position along the frame axis;

a pair of pivoting members pivotably mounted to the movable mounting plate along parallel pivot axes; and

a support rail mounted to each pivoting member, the support rails being laterally separated by less than the outer diameter of the flange with the movable mounting plate in the first position such that the support rails are capable of supporting the mold by the flange above the offsetable member, the pivoting members pivoting between the first and second positions such that, with the movable mounting plate in the second position, the support rails are separated by more than the outer diameter of the flange and incapable of supporting the mold by the flange.

11. An apparatus according to Claim 10 further comprising:

a fixed mounting plate operably engaged with the frame; and

at least one biasing device operably engaged between the fixed mounting plate and the movable mounting plate, the at least one biasing device being configured to bias the movable mounting plate away from the fixed mounting plate from the first position to the second position.

12. An apparatus according to Claim 11 further comprising a pivot element operably engaged between the fixed mounting plate and each of the pivoting members, the fixed mounting plate and the pivoting members being disposed on opposite sides of the movable mounting plate.

13. An apparatus according to Claim 12 wherein the pivot elements are configured such that, when the at least one biasing device biases the movable mounting plate away from the fixed mounting plate so as to move the mold into engagement with the offsetable member, the pivot elements restrain the pivoting members with respect to the fixed mounting plate so as to cause the pivoting members to pivot about the respective pivot axes so as to separate the support rails and release the mold such that the mold is supported by the offsetable member.

14. An apparatus according to Claim 1 wherein the second end of the mold defines a radiused bearing surface extending about an inner circumference thereof, and the offsetable member defines a radiused bearing surface complementarily corresponding to the second end bearing surface of the mold, the offsetable member bearing surface being capable of movably engaging the second end bearing surface as the mold is gyrated.

15. A gyratory compactor apparatus adapted to interact with a generally cylindrical mold having an outer diameter and defining an axis, the mold also having opposed first and second ends and a radially extending flange having an outer diameter, and the mold being adapted to have a sample disposed therein, said gyratory compactor apparatus comprising:

a frame defining an axis;

an offsetable member operably engaged with the frame and configured to be capable of engaging the second end of the mold, the offsetable member being further configured to be capable of being displaced from the frame axis and concurrently movable in an orbital motion about the frame axis;

a pressure ram operably and movably engaged with the frame and configured to be capable of moving along the frame axis;

a mold-engaging device operably engaged with the frame and adapted to receive the mold such that the mold axis corresponds to the frame axis and such that the pressure ram is capable of moving axially within the mold to apply a compaction pressure on the sample within the mold, the pressure

ram thereby maintaining a portion of the mold at a gyration point along the frame axis, the mold-engaging device being further configured to axially move the second end of the mold into engagement with the offsetable member and to then release the mold such that the mold is independent thereof; and

a securing device operably engaged with the offsetable member and movable therewith, the securing device being configured to reversibly engage the second end of the mold so as to secure the second end of the mold to the offsetable member as the second end of the mold is moved in the orbital motion by the offsetable member, the mold thereby being gyrated and capable of being dynamically maintained at a gyration angle related to the displacement of the offsetable member, the gyration point, and the frame axis.

16. An apparatus according to Claim 15 further comprising a rotatable member configured to be rotatable about the frame axis, the rotatable member being configured to support the offsetable member such that the offsetable member is laterally movable with respect thereto.

17. An apparatus according to Claim 15 further comprising a controller in communication with and capable of controlling the pressure ram and the offsetable member, the controller being configured to dynamically direct the pressure ram to apply and maintain the compaction pressure and the offsetable member to provide and maintain the gyration angle.

18. An apparatus according to Claim 17 further comprising a compaction pressure sensing device in communication with the controller and configured to determine the compaction pressure exerted on the sample.

19. An apparatus according to Claim 17 further comprising a mold angle sensing device in communication with the controller and configured to determine the gyration angle of the mold.

20. An apparatus according to Claim 15 further comprising an anti-rotation device operably engaged with the frame, the anti-rotation device being configured to be capable of engaging the mold as the mold is being gyrated so as to substantially prevent the mold from rotating about the mold axis.

21. An apparatus according to Claim 15 wherein the mold-engaging device further comprises:

a movable mounting plate configured to be movable between a first position and a second position along the frame axis;

a pair of pivoting members pivotably mounted to the movable mounting plate along parallel pivot axes; and

a support rail mounted to each pivoting member, the support rails being laterally separated by less than the outer diameter of the flange with the movable mounting plate in the first position such that the support rails are capable of supporting the mold by the flange above the offsetable member, the pivoting members pivoting between the first and second positions such that, with the movable mounting plate in the second position, the support rails are separated by more than the outer diameter of the flange and incapable of supporting the mold by the flange.

22. An apparatus according to Claim 21 further comprising:

a fixed mounting plate operably engaged with the frame; and

at least one biasing device operably engaged between the fixed mounting plate and the movable mounting plate, the at least one biasing device being configured to bias the movable mounting plate away from the fixed mounting plate from the first position to the second position.

23. An apparatus according to Claim 22 further comprising a pivot element operably engaged between the fixed mounting plate and each of the pivoting members, the fixed mounting plate and the pivoting members being disposed on opposite sides of the movable mounting plate.

24. An apparatus according to Claim 23 wherein the pivot elements are configured such that, when the at least one biasing device biases the movable mounting plate away from the fixed mounting plate so as to move the mold into engagement with the offsetable member, the pivot elements restrain the pivoting members with respect to the fixed mounting plate so as to cause the pivoting members to pivot about the respective pivot axes so as to separate the support rails and release the mold such that the mold is in engagement with and supported by the offsetable member.

25. An apparatus according to Claim 15 wherein the second end of the mold defines a radiused bearing surface extending about an inner circumference thereof, and the offsetable member defines a radiused bearing surface complementarily corresponding to the second end bearing surface of the mold, the offsetable member bearing surface being capable of movably engaging the second end bearing surface as the mold is gyrated.

26. A gyratory compactor apparatus adapted to interact with a generally cylindrical mold having an outer diameter and defining an axis, the mold also having opposed first and second ends and a radially extending flange having an outer diameter, and the mold being adapted to have a sample disposed therein, said gyratory compactor apparatus comprising:

a frame defining an axis and configured to receive the mold;

a pressure ram operably and movably engaged with the frame and configured to be capable of moving along the axis thereof, the pressure ram being further capable of being received by and operably engaging the mold through the first end, and moving within the mold to apply a compaction pressure on the sample within the mold, the pressure ram thereby

maintaining a portion of the mold at a gyration point along the frame axis; and

an offsetable member operably engaged with the frame and configured to be capable of engaging the second end of the mold, the offsetable member being further configured to be capable of being displaced from the frame axis and concurrently movable in an orbital motion about the frame axis, such that the second end of the mold is moved in the orbital motion, the mold thereby being gyrated and capable of being dynamically maintained at a gyration angle related to the displacement of the offsetable member, the gyration point, and the frame axis.

27. An apparatus according to Claim 26 further comprising a rotatable member configured to be rotatable about the frame axis, the rotatable member being configured to support the offsetable member such that the offsetable member is laterally movable with respect thereto.

28. An apparatus according to Claim 26 further comprising a controller in communication with and capable of controlling the pressure ram and the offsetable member, the controller being configured to dynamically direct the pressure ram to apply and maintain the compaction pressure and the offsetable member to provide and maintain the gyration angle.

29. An apparatus according to Claim 28 further comprising a compaction pressure sensing device in communication with the controller and configured to determine the compaction pressure exerted on the sample.

30. An apparatus according to Claim 28 further comprising a mold angle sensing device in communication with the controller and configured to determine the gyration angle of the mold.

31. An apparatus according to Claim 26 further comprising an anti-rotation device operably engaged with the frame, the anti-rotation device being configured to be capable of engaging the mold as the mold is being gyrated so as to substantially prevent the mold from rotating about the mold axis.

32. An apparatus according to Claim 26 further comprising a mold-engaging device operably engaged with the frame and configured to receive the mold such that the mold axis corresponds to the frame axis and the pressure ram can be received through the first end of the mold to apply a compaction pressure on the sample within the mold, the mold-engaging device being further configured to axially move the second end of the mold into engagement with the offsetable member.

33. An apparatus according to Claim 32 wherein the mold-engaging device further comprises:

a movable mounting plate configured to be movable between a first position and a second position along the frame axis;

a pair of pivoting members pivotably mounted to the movable mounting plate along parallel pivot axes; and

a support rail mounted to each pivoting member, the support rails being laterally separated by less than the outer diameter of the flange with the movable mounting plate in the first position such that the support rails are capable of supporting the mold by the flange above the offsetable member, the pivoting members pivoting between the first and second positions such that, with the movable mounting plate in the second position, the support rails are separated by more than the outer diameter of the flange and incapable of supporting the mold by the flange.

34. An apparatus according to Claim 33 further comprising:

a fixed mounting plate operably engaged with the frame; and

at least one biasing device operably engaged between the fixed mounting plate and the movable mounting plate, the at least one biasing device being

configured to bias the movable mounting plate away from the fixed mounting plate from the first position to the second position.

35. An apparatus according to Claim 34 further comprising a pivot element operably engaged between the fixed mounting plate and each of the pivoting members, the fixed mounting plate and the pivoting members being disposed on opposite sides of the movable mounting plate.

36. An apparatus according to Claim 35 wherein the pivot elements are configured such that, when the at least one biasing device biases the movable mounting plate away from the fixed mounting plate so as to move the mold into engagement with the offsetable member, the pivot elements restrain the pivoting members with respect to the fixed mounting plate so as to cause the pivoting members to pivot about the respective pivot axes so as to separate the support rails and release the mold such that the mold is in engagement with and supported by the offsetable member.

37. An apparatus according to Claim 26 wherein the second end of the mold defines a radiused bearing surface extending about an inner circumference thereof, and the offsetable member defines a radiused bearing surface complementarily corresponding to the second end bearing surface of the mold, the offsetable member bearing surface being capable of movably engaging the second end bearing surface as the mold is gyrated.

38. A gyratory compactor apparatus defining an axis, said apparatus comprising:

a pressure ram configured to be capable of moving along the apparatus axis;

a rotatable member configured to be rotatable about the apparatus axis;

a mold capable of being disposed between the pressure ram and the rotatable member and adapted to have a sample disposed therein, the mold being generally cylindrical, defining an axis, and having opposed first and second ends, the mold being configured to receive the pressure ram therein

through the first end so as to apply a compaction pressure on the sample within the mold, the pressure ram thereby maintaining a portion of the mold at the gyration point along the apparatus axis, and the second end of the mold defining a radiused bearing surface extending about an inner circumference thereof; and

an offsetable member operably engaged with the rotatable member and defining a radiused bearing surface complementarily corresponding to the second end bearing surface of the mold, the offsetable member bearing surface being capable of movably engaging the second end bearing surface of the mold, the offsetable member being further configured to be displaceable with respect to the rotatable member from the apparatus axis so as to cause the second end of the mold to orbit about the apparatus axis when the offsetable member is rotated by the rotatable member, the mold thereby being gyrated at a gyration angle related to the displacement of the offsetable member, the gyration point, and the apparatus axis.

39. An apparatus according to Claim 38 further comprising a securing device operably engaged with the offsetable member and configured to secure the second end of the mold to the offsetable member as the mold is gyrated.

40. An apparatus according to Claim 38 further comprising a controller in communication with and capable of controlling the pressure ram and the offsetable member, the controller being configured to dynamically direct the pressure ram to apply and maintain the compaction pressure and the offsetable member to provide and maintain the gyration angle.

41. An apparatus according to Claim 40 further comprising a compaction pressure sensing device in communication with the controller and configured to determine the compaction pressure exerted on the sample.

42. An apparatus according to Claim 40 further comprising a mold angle sensing device in communication with the controller and configured to determine the gyration angle of the mold.

43. An apparatus according to Claim 38 further comprising an anti-rotation device configured to be capable of engaging the mold as the mold is being gyrated so as to substantially prevent the mold from rotating about the mold axis.

44. A device adapted to interact with a generally cylindrical mold for a gyratory compactor apparatus defining an axis, the mold having an outer diameter and defining an axis, the mold also having opposed first and second ends and a radially extending flange having an outer diameter, and the mold being adapted to have a sample disposed therein, said device comprising:

a movable mounting plate configured to be movable between a first position and a second position along the apparatus axis;

a pair of pivoting members pivotably mounted to the movable mounting plate along parallel pivot axes; and

a support rail mounted to each pivoting member, the support rails being laterally separated by less than the outer diameter of the flange with the movable mounting plate in the first position such that the support rails are capable of supporting the mold by the flange, the pivoting members pivoting between the first and second positions such that, with the movable mounting plate in the second position, the support rails are separated by more than the outer diameter of the flange and are thereby incapable of supporting the mold by the flange.

45. A device according to Claim 44 further comprising:

a fixed mounting plate; and

at least one biasing device operably engaged between the fixed mounting plate and the movable mounting plate, the at least one biasing device being

configured to bias the movable mounting plate away from the fixed mounting plate.

46. A device according to Claim 45 further comprising a pivot element operably engaged between the fixed mounting plate and each of the pivoting members, the fixed mounting plate and the pivoting members being disposed on opposite sides of the movable mounting plate.

47. A device according to Claim 46 wherein the pivot elements are configured such that, when the at least one biasing device biases the movable mounting plate away from the fixed mounting plate, the pivot elements restrain the pivoting members with respect to the fixed mounting plate so as to cause the pivoting members to pivot about the respective pivot axes so as to separate the support rails.

48. A pressure-measuring device adapted for use with a gyratory compactor apparatus, said device comprising:

a pressure-bearing member;

an elongate stem member defining an axis and having a first end operably engaged with the pressure-bearing member and an opposing second end;

an elongate sleeve configured to extend concentrically over the stem member in close relation thereto so as to be capable of slidably engaging the stem member over an extended engagement length, the sleeve having a first end extending toward the pressure-bearing member, when the sleeve is engaged with the stem member, and an opposing second end; and

a load-determining device in communication with the sleeve such that load-determining device is axially fixed with respect to the sleeve, the load-determining device being further configured to be in communication with the stem member so as to measure an actual axial load exerted on the pressure-bearing member via the stem member.

49. A device according to Claim 48 further comprising a screw mechanism operably engaged about and axially fixed with respect to the second end of the sleeve, the screw mechanism further being operably engaged with the load-determining device and extending to the end of the stem member opposing the pressure-bearing member, the screw mechanism also being configured such that rotation thereof about the axis causes an axial displacement of the pressure-bearing member via the stem member.

50. A device according to Claim 49 wherein the load-measuring device is operably engaged with the screw mechanism so as to measure the actual axial load exerted on the pressure-bearing member via the stem member and the screw mechanism.

51. A device according to Claim 48 further comprising a controller in communication with the load-measuring device and the screw mechanism and capable of controlling the screw mechanism, the controller being configured to dynamically determine the actual axial load from the load-measuring device, compare the actual axial load to a desired axial load, and, if the actual axial load is different from the desired axial load, direct the screw mechanism to axially displace the pressure-bearing member until the actual axial load corresponds to the desired axial load.

52. A device adapted to determine and maintain an angle of gyration of a mold engaged with a gyratory compactor apparatus defining an axis, the mold being generally cylindrical, defining an axis, and having opposed first and second ends, the mold being gyratable about the apparatus axis at a gyration point displaced from the second end toward the first end, said device comprising:

an offsetable member adapted to be capable of engaging the second end of the mold in displacement from the apparatus axis and to be movable in an orbital motion about the apparatus axis so as to cause the mold to gyrate with respect to the gyration point, the gyration point being remotely disposed with respect to the second end of the mold;

a sensor device configured to dynamically determine an actual angle of gyration of the mold, the actual angle of gyration being related to the displacement of the offsetable member, the gyration point, and the apparatus axis; and

a controller operably engaged with the offsetable member so as to be capable of directing adjustment of the displacement of the offsetable member to provide a desired angle of gyration with respect to the gyration point, the controller being in communication with the sensor device and responsive thereto so as to be capable of dynamically adjusting the displacement of the offsetable member to maintain the actual angle of gyration substantially equal to the desired angle of gyration.

53. A device according to Claim 52 further comprising a rotatable member configured to be rotatable about the apparatus axis, the rotatable member being configured to support the offsetable member such that the offsetable member is laterally movable with respect thereto.

54. A gyratory compactor apparatus defining an axis, said gyratory compactor apparatus comprising:

a sample-manipulating device adapted to receive a mold having a sample disposed therein, the sample-manipulating device being configured so as to be capable of gyrating the mold while applying a compaction pressure to the sample; and

a frame supporting the sample-manipulating device, the frame having at least one component comprising a laminated sheet material.

55. An apparatus according to Claim 54 wherein the at least one component is configured such that the laminated sheet material reinforces at least a portion thereof.

56. An apparatus according to Claim 54 wherein the at least one component defines a channel and the laminated sheet material forms at least a portion of the channel.

57. An apparatus according to Claim 54 wherein the frame further comprises a plurality of components having at least two adjacent components engaged at an interface, at least one of the adjacent components being formed, about the interface, of the laminated sheet material so as to reinforce the engagement between the adjacent components.

58. A cleaning device adapted to remove sample residue from a gyratory compactor apparatus defining an axis, the gyratory compactor apparatus being further adapted to have an offsetable member operably engaged with a rotatable member configured to be rotatable about the axis, the offsetable member being adapted to be capable of engaging an end of a mold having a gyration point disposed away from the end and to be capable of being displaced from the axis so as to cause the mold to gyrate with respect to the gyration point when the offsetable member is orbited about the axis by the rotatable member, said cleaning device comprising:

a plate having a first face supporting the rotatable member and configured to be non-rotatable about the axis, the plate having a second face opposing the first face and defining a groove in the first face disposed radially outward of the rotatable member, the groove being configured to collect the sample residue, the plate further defining a channel extending from the groove toward the second face, the channel being configured to facilitate removal of the sample residue from the gyratory compactor; and

a sweeping member configured to orbit about the axis in operable engagement with the groove defined by the plate, the sweeping member being further configured so as to move the sample residue along the groove and to direct the sample residue to the channel for removal from the gyratory compactor.

59. A device according to Claim 58 wherein the sweeping member is operably engaged with the rotatable member and movable therewith such that the rotatable member causes the sweeping member to orbit about the axis as the rotatable member is rotated.

60. A device according to Claim 58 wherein the sweeping member configured to be selectively orbited about the axis, independently of the rotatable member, in operable engagement with the groove defined by the plate.

61. A method of manufacturing a gyratory compactor apparatus, the gyratory compactor apparatus including a frame having a plurality of components, said method comprising:

operably engaging the components with a jig configured to align the components in a desired relationship;

securing the components together so as to form the frame, the frame defining an axis and having alignment members operably engaged therewith;

removing the frame from the jig; and

operably engaging a sample-manipulating device having a plurality of components with the frame, the sample-manipulating device being adapted to receive a mold capable of receiving a sample therein and being configured so as to be capable of gyrating the mold while applying a compaction pressure to the sample, the components of the sample-manipulating device having alignment members, corresponding to the frame alignment members, operably engaged therewith so as to facilitate alignment of the sample-manipulating device with respect to the axis when the sample-manipulating device is operably engaged with the frame.

62. A method according to Claim 61 further comprising forming at least a portion of at least one of the components from a laminated sheet material.